# Unit 3 KUDs

**DNA and Protein Synthesis:**

As a result of this unit, the learner will KNOW:

* The components of nucleotides
* The pairing rules for A, T, G, C, U
* The structure of nucleic acids
* The difference between DNA and RNA

As a result of this unit, the learner will UNDERSTAND:

* That nucleic acids store information vital to the survival of organisms
* That nucleic acids have different jobs, depending on where they’re found and what type they are
* That mistakes in nucleic acids have varying degrees of harm, or may not cause harm at all

As a result of this unit, the learner will be able to:

* Draw and distinguish between the structures of DNA and RNA
* Make mRNA from a DNA template
* Distinguish between the codon and anticodon sides of the DNA molecule
* Using codons, make the resultant polypeptide
* Describe the role of mRNA, tRNA, and rRNA in protein synthesis
* Recognize mutations and how harmful they are based on amino acid sequence changes

**DNA Tech:**

As a result of this unit, the learner will KNOW:

* The steps involved in getting recombinant DNA
* How a gel is made
* The steps to reproductive cloning
* The implications of the human genome project and gene therapy

As a result of this unit, the learner will UNDERSTAND:

* That manipulations of the DNA molecule result in helpful advances for humans
* That using restriction enzymes, DNA reveals characteristics unique to each person
* That DNA manipulation should be done responsibly

As a result of this unit, the learner will be able to:

* Read a gel to determine paternity and to determine someone’s presence at a crime scene
* Cut a piece of DNA using restriction enzymes to insert a gene of interest
* Insert a desired gene into a plasmid
* Describe how plants are transformed
* Discuss the ethical implications of stem cell research, gene therapy, and GMOs

**From the NC Curriculum:**

**Bio.3.1.1**

Develop a cause-and-effect model relating the structure of DNA to the functions of replication and protein synthesis:

▪ The structure of DNA is a double helix or “twisted ladder” structure. The sides are composed of alternating phosphate-sugar groups and “rungs of the DNA ladder” are composed of complementary nitrogenous base pairs (always adenine, A, to thymine, T, and cytosine, C, to guanine, G) joined by weak hydrogen bonds.

▪ The sequence of nucleotides in DNA codes for proteins which is central key to cell function and life.

▪ Replication occurs during the S phase of the cell cycle and allows daughter cells to have an exact copy of parental DNA.

**Bio 3.1.2**

• Explain the process of protein synthesis:

▪ Transcription that produces an RNA copy of DNA

▪ mRNA traveling to the ribosome (rRNA)

▪ Translation – tRNA supplies appropriate amino acids

▪ Amino acids are linked by peptide bonds to form polypeptides. Polypeptide chains form protein molecules. Proteins can be structural (forming a part of the cell materials) or functional (hormones, enzymes, or chemicals involved in cell chemistry).

• Interpret a codon chart to determine the amino acid sequence produced by a particular sequence of bases.

• Explain how an amino acid sequence forms a protein that leads to a particular function and phenotype (trait) in an organism.

**Bio.3.1.3**

• Understand that mutations are changes in DNA coding and can be deletions, additions, or substitutions. Mutations can be random and spontaneous or caused by radiation and/or chemical exposure.

• Develop a cause and effect model in order to describe how mutations change amino acid sequence

**Bio.3.3.1**

• Summarize the process of gel electrophoresis as a technique to separate molecules based on size. Students should learn the general steps of gel electrophoresis – using restrictions enzymes to cut DNA into different sized fragments and running those fragments on gels with longer fragments moving slower than faster ones.

• Interpret or “read” a gel.

• Exemplify applications of DNA fingerprinting - identifying individuals; identifying and cataloging endangered species. Bio.3.3.2

• Generalize the applications of transgenic organisms (plants, animals, & bacteria) in agriculture and industry including pharmaceutical applications such as the production of human insulin.

• Summarize the steps in bacterial transformation (insertion of a gene into a bacterial plasmid, getting bacteria to take in the plasmid, selecting the transformed bacteria, and producing the product). Bio.3.3.3

• Identify the reasons for establishing the Human Genome Project.

• Recognize that the project is useful in determining whether individuals may carry genes for genetic conditions and in developing gene therapy.

• Evaluate some of the science of gene therapy. (e.g. Severe Combined Immunodeficiency and Cystic Fibrosis)

• Critique the ethical issues and implications of genomics and biotechnology (stem cell research, gene therapy and genetically modified organisms).

**Bio.4.1.2**

• Recall that the sequence of nucleotides in DNA codes for specific amino acids which link to form proteins.

• Identify the five nitrogenous bases (A, T, C, G and U) found in nucleic acids as the same for all organisms.

• Summarize the process of protein synthesis.

**Topics for Honors Extensions:**

1. Make tRNA from a DNA template
2. Use the term RFLP
3. That restriction enzymes make sticky ends